

Description

VARIABLE-DUCT SUPPORT ASSEMBLY

BACKGROUND OF INVENTION

- [0001] The present invention relates generally to ductwork, and more particularly to a variable-duct support assembly for mounting ducts of various shapes and sizes onto an airframe or other suitable structures.
- [0002] Aircraft manufacturers are well known for producing aircrafts having HVAC systems or various other systems with ductwork integrated therein. This ductwork typically is comprised of a series of cylindrical tubing or ducts for passing air throughout the aircraft. Typically, each duct requires a plurality of support assemblies for mounting the duct to the airframe of the aircraft. Moreover, each support assembly can be comprised of a substantial number of parts and have a somewhat complex construction. In this way, these support assemblies can result in expensive material costs, lengthy installation times, and high labor costs associated therewith.
- [0003] Additionally, existing support assemblies can be sized for

mounting only specific ducts of certain shapes and sizes. In other words, differently sized or shaped ducts can each require its own separate support assembly for attaching the respective duct to the airframe. This condition can require new tooling and further increase the time required to install the ductwork.

- [0004] It would therefore be desirable to provide a variable-duct support assembly and method for installing ductwork, which provides for ease of use and common components, as well as a reduction of costs.

SUMMARY OF INVENTION

- [0005] One embodiment of the present invention is a variable-duct support assembly for mounting one or more ducts thereon. This variable-duct support assembly includes one or more rails each having a groove. These grooves have one or more pairs of support brackets positioned therein for supporting a proximal surface of the ducts. The support brackets are coupled to one or more flexible bands and utilized for clamping the duct between the support brackets and the flexible bands. The flexible bands contact and wrap around the duct so as to distribute the load substantially across the distal surface. Likewise, the support brackets each include support por-

tions for distributing the load substantially across a proximal surface of each duct.

- [0006] One advantage of the invention is that a variable-duct support assembly is provided that can distribute a load substantially across the surface of a duct and decrease the likelihood of inadvertently deforming the ducts during installation of the ductwork.
- [0007] Another advantage of the invention is that a variable-duct support assembly is provided that has a robust and common construction for mounting ducts of various shapes and sizes thereon, which decreases installation time and minimizes labor costs associated therewith.
- [0008] Still another advantage of the invention is that a variable-duct support assembly is provided that can eliminate the need for new tooling associated with new configurations, e.g. differently shaped or sized ducts.
- [0009] Yet another advantage of the invention is that a variable-duct assembly is provided that has substantially few parts thereby simplifying the manufacture of the assembly, decreasing the costs associated therewith, and improving the installation of ducts onto the assembly.
- [0010] The features, functions, and advantages can be achieved independently and in various embodiments of the present

invention or may be combined in yet other embodiments.

BRIEF DESCRIPTION OF DRAWINGS

- [0011] For a more complete understanding of this invention, reference should now be made to the embodiments illustrated in greater detail in the accompanying drawings and described below by way of examples of the invention:
- [0012] FIGURE 1A is a perspective view of a variable-duct support assembly being configured for supporting one duct that has a circular cross-section, according to one advantageous embodiment of the invention;
- [0013] FIGURE 1B is a perspective view of the variable-duct support assembly shown in FIGURE 1B, being configured for supporting another duct that has an oval cross-section;
- [0014] FIGURE 1C is an end view of a duct assembly that includes two differently sized circular ducts and the variable-duct support assembly shown in FIGURES 1A and 1B being configured for supporting the ducts, according to one advantageous embodiment of the claimed invention;
- [0015] FIGURE 1D is an end view of a duct assembly that includes one oval duct and the variable-duct support assembly shown in FIGURES 1A and 1B being configured for supporting the oval duct, according to another advantageous embodiment of the claimed invention;

- [0016] FIGURE 2 is a cross-sectional view of the variable-duct support assembly shown in FIGURE 1C and two similarly-sized ducts mounted to the variable-duct support assembly, according to another advantageous embodiment of the claimed invention;
- [0017] FIGURE 3 is a partially cutaway perspective view of a rail of the duct assembly shown in FIGURE 1C;
- [0018] FIGURE 4 is an axial view of a rail and a support bracket of the duct assembly shown in FIGURE 1C;
- [0019] FIGURE 5 is a perspective view one of the support brackets shown in FIGURE 1C;
- [0020] FIGURE 6 is an top elevation view one of the support brackets shown in FIGURE 5, as taken along arrow 6 shown in Figure 5;
- [0021] FIGURE 7 is a side elevation view one of the support brackets shown in FIGURE 5, as taken along arrow 7 shown in Figure 5;
- [0022] FIGURE 8 is an axial elevation view one of the support brackets shown in FIGURE 5, as taken along arrow 8 shown in Figure 5;
- [0023] FIGURE 9A is a perspective view of a support bracket, according to another advantageous embodiment of the invention;

- [0024] FIGURES 9B–9C are partially cutaway views of a duct assembly having the support bracket shown in FIGURE 9A, respectfully illustrating a support portion of the support before and after contacting a proximal surface of the duct; and
- [0025] FIGURE 10 is a logic flow diagram showing a method for installing a duct assembly in an airframe utilizing an embodiment of the present invention.

DETAILED DESCRIPTION

- [0026] In the following figures the same reference numerals will be used to illustrate the same components in the various views. The embodiments described herein employ features where the context permits, e.g. when a specific result or advantage of the claimed invention is desired. However, a variety of other embodiments are contemplated having different combinations of the described features, having features other than those described herein, or even lacking one or more of the described features. Specifically, the embodiments described herein implement a variable-duct support assembly for installing ductwork in an aircraft. Yet, it is contemplated that the variable-duct support assembly can be utilized for various other suitable applications and environments, e.g. other vehi-

cles and buildings. For these reasons, it is understood that the invention can be carried out in various modes.

- [0027] Referring to Figures 1A and 1B, there respectively are shown perspective views of a variable-duct support assembly 14 configured for supporting a duct having a circular cross-section and a duct having an oval cross-section, according to one advantageous embodiment of the invention. As detailed below, it will be appreciated that the variable-duct support assembly 14 can be configured for supporting various pluralities of sizes and shapes of ducts.
- [0028] Referring now to Figure 1C, there generally is shown an end view of a duct assembly 10, which is comprised of two circular cross-sectional ducts 12a, 12b and a variable-duct support assembly 14 that is configured for mounting the ducts 12a, 12b onto a suitable portion of an airframe 16, according to one advantageous embodiments of the invention. In this example, the variable-duct support assembly 14 is configured for mounting a three-inch diameter duct 12a and a four-inch diameter duct 12b to the airframe 16. However, it is understood that the variable-duct support assembly can instead be configured for mounting various pluralities of shapes and sizes of the

ducts.

- [0029] For example, referring now to Figure 1D, there is shown an end view of a duct assembly 10, which is comprised of one oval cross-sectional duct 12c and a variable-duct support assembly 14 that is configured for mounting the duct 12c onto a suitable portion of an airframe 16, according to another advantageous embodiments of the invention. In addition, it is also contemplated that the variable-duct support assembly 14 can be utilized for securing various other objects besides ducts onto other suitable structures, e.g. other vehicles and buildings.
- [0030] Referring now to Figure 2, there is shown a cross-sectional view of the variable-duct support assembly 14 shown in Figure 1C for use in mounting two similarly sized and shaped ducts 12a, according to another advantageous embodiment of the invention.
- [0031] As shown in Figures 1A-1D and 2, the variable-duct support assembly 14 generally includes a rail 18, which is adapted to be attached to the airframe 16 or other surface. The rail 18 has two pairs of support brackets 20 coupled thereto. However, it is contemplated that more or fewer support brackets 20 can be utilized as desired. Each pair of support brackets 20 is utilized for supporting a

proximal surface 22 of the duct 12a and securing the duct 12a to the airframe 16 or other surface. Each of the pairs of support brackets 20 have a flexible band 24 coupled thereto and is positioned for contacting a distal surface 26 of the ducts 12 and clamping the respective ducts 12a between the flexible band 24 and the support brackets 20.

- [0032] Referring now to Figures 2, 6, and 7, each support bracket 20 has a support portion 28 for contacting a substantial amount of the duct's proximal surface 22. In this embodiment, the support portion 28 is a curved surface of the support bracket 20 itself. As best shown in Figures 1C and 1D, this curved surface has a predetermined radius of curvature for supporting circular, semi-circular, and/or oval ducts having contours within a predetermined range of diameters. For example, the curved surface can be sufficient for providing substantially distributed support to the proximal surfaces of circular cross-sectional ducts, which have diameters substantially within the range from three inches to four inches. However, it is contemplated that the support portion 28 can be shaped and sized for supporting ducts of various other shapes and sizes as desired. Moreover, as detailed in the description for Figure

3, the support brackets 20 can be spaced apart from each other on the rail 18 for supporting various sized ducts.

[0033] For instance, in another advantageous embodiment shown in Figures 9A–9C, the support portion 28" is a resilient belt member coupled to opposing ends 30, 30 of a support bracket 20. Specifically, Figure 9B shows the resilient belt member prior to receiving the duct 12 thereon. Also, Figure 9C shows the resilient belt member conforming to the proximal surface 22 of the duct 12 so as to distribute a load substantially across this proximal surface 22. In this embodiment, the support bracket 20 is comprised of two tab portions 32, 32" extending substantially perpendicularly from each other. These tab portions 32, 32" define a region of elasticity 34 within which the resilient belt member can stretch and conform to the duct's proximal surface 22. The resilient belt member is comprised of a rubber material or various other suitable materials which can conform to the proximal surface 22 of the duct 12 and still be sufficiently stiff for supporting the duct 12. In this way, the support portion 28 can distribute a load substantially across the proximal surface 22 of various shaped and sized ducts while minimizing the risk of inadvertently deforming those ducts.

- [0034] In addition, each support bracket 20 is comprised of a plastic material and manufactured from an injection molding process. However, it will be appreciated that the support bracket can be comprised of various other suitable materials and made from other suitable manufacturing processes, namely a steelmaking process, a rolling process, a casting process, a forging process, an extrusion process, a drawing process, a welding process, or any combination thereof.
- [0035] Referring now primarily to Figures 5–8, the flexible band 24 introduced hereinabove is coupled to each support bracket 20 via a notch 36 and an aperture 38 formed in the support bracket 20. Specifically, as best shown in Figure 2, the flexible band 24 is a tie-wrap member passing through the notch 36 and the aperture 38. However, it is contemplated that the flexible band 24 can be a metal band, a rubber belt member, a woven fabric belt member, or various other suitable belt members. The notch 36 and the aperture 38 allow the flexible band 24 to attach to the support brackets 20 and wrap around both the support brackets 20 and the duct 12. For that reason, the flexible band 24 can clamp the duct 12 against the support brackets 20. It is understood that the flexible band 24 can be

coupled to the support brackets in various other suitable ways as desired.

- [0036] In addition, this flexible band 24 can conform to the distal surface 26 of the duct 12 and substantially distribute a load across the distal surface 26. In this regard, both the flexible band 24 and the support portion 28 of the support bracket 20 can be utilized in combination for distributing a clamping load across a substantial portion of the duct's perimeter. This feature is beneficial because it can decrease the likelihood of a load being concentrated on a discrete portion of the duct's perimeter, which can otherwise cause that portion to be inadvertently deformed.
- [0037] Referring now to Figure 3, the rail 18 has a groove 40 formed therein for receiving the support brackets 20. The rail is preferably manufactured from an extrusion process. It will be appreciated that the rail can be comprised of a variety of suitable materials and be manufactured from other suitable processes, including a steelmaking process, a rolling process, a casting process, a forging process, an extrusion process, a drawing process, a welding process, or any combination thereof.
- [0038] As best shown in Figure 4, each support bracket 20 has a

pair of flanges 42 extending therefrom for contacting the rail 18 within the groove 40 and providing a tongue-in-groove fitting between each support bracket and the rails 18. As exemplified in Figures 1C, 1D and 2, this tongue-in-groove fitting allows the identically shaped and sized support brackets 20 to be moved along a longitudinal axis 44 of the rail 18 and positioned relative to each other for supporting ducts 12 of various shapes and sizes. Specifically, with attention to Figure 1C, a first pair 46 of support brackets 20 can directly abut each other for supporting a somewhat smaller-sized duct, e.g. a three-inch diameter duct. Moreover, a second pair 48 of support brackets 20 can be sufficiently spaced apart at a distance D_1 from each other for supporting a larger-sized duct, e.g. a four-inch diameter duct. Furthermore, referring now to Figure 1D, a third pair 50 of support brackets 20 can be sufficiently spaced apart at a distance D_2 for supporting the oval cross-sectional duct 12. In each of these examples, the support brackets 20 are spaced from each other at a predetermined distance for placing the support portions 28 of the support brackets 20 in a sufficient position for contacting a maximum amount of the duct's proximal surface 22. In this way, as explained herein-

above, those support portions 28 can distribute a load across a substantially large area of the duct's surface and decrease the likelihood of inadvertently deforming the duct 12. However, it is also understood that the support brackets 20 can be differently sized or shaped for supporting substantially larger or smaller ducts as desired.

- [0039] As shown in Figures 2 and 3, each rail 18 further includes a series of openings 52 for passing the flexible band 24 therethrough and allowing the flexible band 24 to secure the support brackets 20 and the respective ducts in a pre-determined position on the rail 18. These openings 52 can also be utilized for receiving various fasteners (not shown) that attach for the rail 18 to the airframe 16.
- [0040] It will be appreciated that the duct assembly 10 can include substantially more than two rails 18 as desired, particularly when numerous lengthy and/or heavy ducts 12 require installation.
- [0041] Referring now to Figure 10, there is shown a logic flow diagram showing a method for producing a duct assembly, according to one advantageous embodiment of the invention. This method commences in step 100 and then immediately proceeds to step 102.
- [0042] In step 102, one or more pairs of support brackets 20 are

slidably attached to the rail 18. This step is accomplished by inserting flanges 42, which extend from the support brackets 20, into the groove 40, which is defined by the rail 18. However, it is contemplated that this step can be accomplished by various other suitable methods as desired. Then, the sequence proceeds to step 104.

- [0043] In step 104, one or more ducts are positioned substantially between each pair of support brackets 20. This step can also require that the ducts are aligned substantially perpendicular to the rail 18. However, various other orientations can be utilized as desired. The sequence then proceeds to step 106.
- [0044] In step 106, each pair of support brackets 20 is sufficiently positioned along the longitudinal axis 44 of the rail 18 to place support portions 28 of the support brackets 20 in contact with the proximal surface 22 of the duct 12. In this way, the support portions 28 can distribute a load across the proximal surface 22 and decrease the likelihood of inadvertently deforming the duct 12. This step is accomplished by sliding the support brackets 20 within the groove 40 of the rail 18. Yet, other methods for moving the support brackets 20 can be utilized as desired. Then, the sequence proceeds to step 108.

[0045] In step 108, one or more flexible bands 24 are attached to both the support brackets 20 and the rail 18 so as to clamp the duct 12 therebetween. As explained above, the flexible band 24 can be a tie wrap member that is secured to the support brackets 20 via the aperture 38 and the notch 36 formed in the support brackets 20. The tie-wrap member can be further secured to the rail 18 via the openings 52 formed in the rail 18. In this way, the flexible band 24 can conform to the distal surface 26 of the duct 12 and distribute a load substantially across the distal surface 26. This feature further decreases the likelihood of inadvertently deforming the duct 12. However, it is understood that the flexible band can instead be metal band, a woven cloth fabric member, a rubber belt member, or various other suitable belt members as desired. Furthermore, other suitable methods can be utilized for accomplishing this step.

[0046] While particular embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.